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(54) Heat exchanger.

(57) A heat exchanger has a number of parallel tubes 14 enclosed within a shell 10 and having an inlet 12 and an outlet 13 for passing fluid through the tubes. Fin elements 20 extend across the tubes to form secondary heat exchange surfaces and another fluid is fed between the tubes to pass over the elements.

The elements 20 have openings 25 between the tubes 14 and the openings are flanked by tags 26.

The tubes 14 are spaced apart such that the available cross-section for the other fluid is constant.

The tubes 14 are in rows R transverse to the flow and the spacing between tubes in the rows R is greater than between tubes in adjacent rows R.

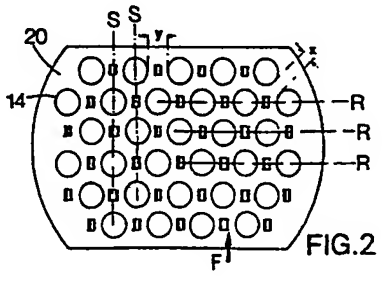

FIG.2

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HEAT EXCHANGER

This invention relates to heat exchangers and particularly to heat exchangers of the kind having a plurality of parallel tubes enclosed within a shell and having an inlet and an outlet for passing fluid through the tubes. A plurality of fin elements extend across the tubes to form secondary heat exchange surfaces and another fluid is fed between the tubes to pass over the secondary surfaces.

Heat exchangers of this kind have been disclosed in British Patents 717,613 and 1,544,927. In some cases the secondary surface fin elements have been formed with louvres or slits to improve the heat transfer characteristics of the heat exchanger.

It has also been proposed in British Patent 818,589 to provide fin and tube heat exchangers in which the tubes pass through the fins and in the spaces between the tubes the fins are formed with pairs of flanges.

It is an object of the invention to provide a heat exchanger of the kind described in which the heat exchange characteristics are enhanced.

According to the invention a heat exchanger comprises a plurality of circular-section tubes parallel to and spaced from one another, a shell disposed around the tubes, an inlet and an outlet for passing fluid through the tubes, a plurality of secondary surface fin elements lying in parallel planes extending transverse to the tubes, and inlet and outlet means for feeding a further fluid through the spaces between the tubes and over the elements in a direction generally parallel thereto, the elements each being formed with openings between the tubes and the openings being flanked by tags extending transverse to the planes of the elements, the tubes being arranged with

spacings between the tubes to achieve a substantially constant cross-section in the direction of flow of said further fluid. In an arrangement of tubes in which the tubes are in rows transverse to the direction of flow and the tubes of alternate rows are staggered by one half the pitch of the tubes in each row, the spacing of the tubes in each row from one another is greater than the spacing of the tubes in one row from the tubes in adjacent transverse rows. Preferably the spacing of tubes from one another in each row is twice the spacing of the tubes in each row from tubes in adjacent rows. In this way the velocity of said further fluid is kept relatively constant and acceleration and deceleration of the fluid is avoided with consequent reduction in pressure loss across the heat exchanger.

Conveniently the tags lie generally parallel to the direction of flow of said further fluid over the elements and the tags are formed in pairs so that one tag lies to each side of said opening.

Preferably, by the use of baffles, the further fluid is constrained to pass in a generally sinuous path through the space between the tubes and over the fin elements.

Further features of the invention will appear from the following description of an embodiment of the invention given by way of example only and with reference to the drawings, in which:-

Fig. 1 is a part sectional side elevation of a heat exchanger.

Fig. 2 is an elevation of a fin element of the heat exchanger of Fig. 1.

Fig. 3 is an enlarged view of part of the fin of Fig. 2, and

Fig. 4 is a section on the line 4-4 in Fig. 3.

Referring to the drawings and firstly to Fig. 1, a heat exchanger includes a cylindrical shell 10 at the ends of which are manifolds 11 including an outlet pipe 12 and an inlet pipe 13 for fluid acting as a heat transfer medium; for example the fluid may be water.

A plurality of circular-section tubes 14 extend between tube plates 15 bounding the manifolds 11 to conduct the water or other fluid between the inlet and outlet and the tubes lie parallel to and spaced from one another. The tube plates 15 close off the spaces between the tubes 14 from the manifolds 11.

A series of intermediate baffles 17a to 17e are located between the manifolds at right angles to the tubes and spaced from one another. The baffles are spaced alternately from the upper and lower walls of the shell 10.

A plurality of secondary heat exchanger fin elements 20 lie at right angles to and across the tubes 14 and are regularly spaced from one another in the direction of the tubes, the upper and lower edges of the elements 20 being spaced from the upper and lower walls of the shell 10. Inlet and outlet pipes 21 and 22 are located in the upper part of the shell 10 at opposite ends thereof to admit heat exchange medium, for example oil, to the spaces around the tubes. The presence of the baffles 17a to 17e and the fins 20 ensures that the flow path of the oil or other fluid is sinuous and generally parallel to the planes of the elements 20. The fluid flows first down from the inlet 21 over the fins 20, under the baffle 17a, upwards over the fins 20 and over the baffle 17b, and so on, until the fluid leaves the shell upwardly through the outlet 22.

It will be seen, in particular from Fig. 2, that the tubes 14 are arranged to lie in horizontal rows R in one direction, and in a direction at a right angle to said rows R the tubes are in vertical rows S. The rows R lie transverse to the general

direction of flow F and the tubes in alternate rows R are staggered by one half the pitch of the tubes in the rows R. If, as seen in Figs. 2 and 3, the spacing of the tubes in the rows R is $\underline{y}$, the spacing of each tube in a row R from the tubes in adjacent rows R is x and the relationship between x and $\underline{y}$ is such that x is less than $\underline{y}$, and preferably of the order of $\underline{y} = 2x$. Such a spacing ensures that the cross-sectional area of the flow of fluid around the tubes remains substantially constant and the velocity of the fluid is therefore substantially constant thereby avoiding acceleration and deceleration of the fluid. Accordingly pressure loss in the heat exchanger is kept low.

The fins 20 are formed with openings 25 and associated tags 26 as seen in Figs. 3, 4 and 4. Openings are formed between adjacent tubes 14 in rows R and at the ends of rows R. The tags 26 are formed in pairs out of bent over portions of the fin elements 20 and lie at right angles to the planes of the fins. The tags 26 also lie generally parallel to the general direction of flow F and the openings 25 are formed as rectangular openings by the action of forming the tags.

The tags 26 and associated openings 25 provide edges to the fluid thereby reducing boundary layer thickness of fluid on the fins. High heat transfer rates can be achieved without undue pressure losses being created.

CLAIMS

1. A heat exchanger comprising a plurality of circular section tubes 14 parallel to and spaced from one another, a shell 10 disposed around the tubes, an inlet 13 and an outlet 12 for passing fluid through the tubes 14, a plurality of secondary surface fin elements 20 lying in parallel planes extending transverse to the tubes, and inlet and outlet means 21, 22 for feeding a further fluid through the spaces between the tubes and over the elements in a direction F generally parallel to the elements, characterised in that the elements 20 are each formed with openings 25 located between the tubes and the openings are flanked by tags 26 extending transverse to the planes of the elements 20, the spacings between the tubes being arranged to achieve a substantially constant cross-section in the direction of flow F of said further fluid over the elements 20.

2. A heat exchanger according to claim 1 characterised in that the tubes 14 are in rows R arranged transverse to the direction of flow F of said further fluid and the tubes of alternate rows R are staggered by one half the pitch of the tubes in each row.

3. A heat exchanger according to claim 2 characterised in that the spacings of the tubes 14 in each row R from one another is greater than the spacing of the tubes in one row R from tubes in adjacent transverse rows R.

4. A heat exchanger according to claim 3 characterised in that the spacing of tubes 14 from one another in each transverse row R is twice the spacing of the tubes in each transverse row R from tubes in adjacent transverse rows R.

5. A heat exchanger according to any one of the preceding claims characterised in that the tags 26 lie generally parallel to the direction of flow F of said further fluid over the elements 20.

6. A heat exchanger according to any one of the preceding claims characterised in that the tags 26 are in pairs so that a tag lies to each side of said opening 25.

7. A heat exchanger according to any one of the preceding claims characterised in that the shell 10 contains baffles 17a, 17b, 17c, 17d, 17e whereby the further fluid is constrained to pass in a generally sinuous path F through the space between the tubes 14 and over the fin elements 20.

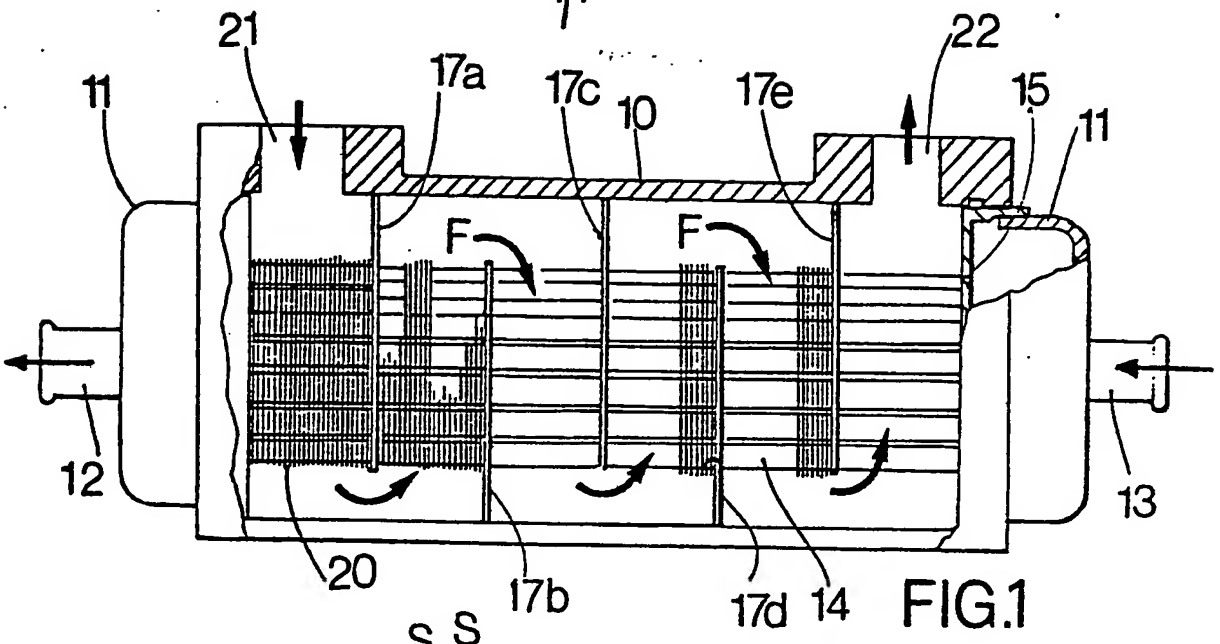

FIG.1

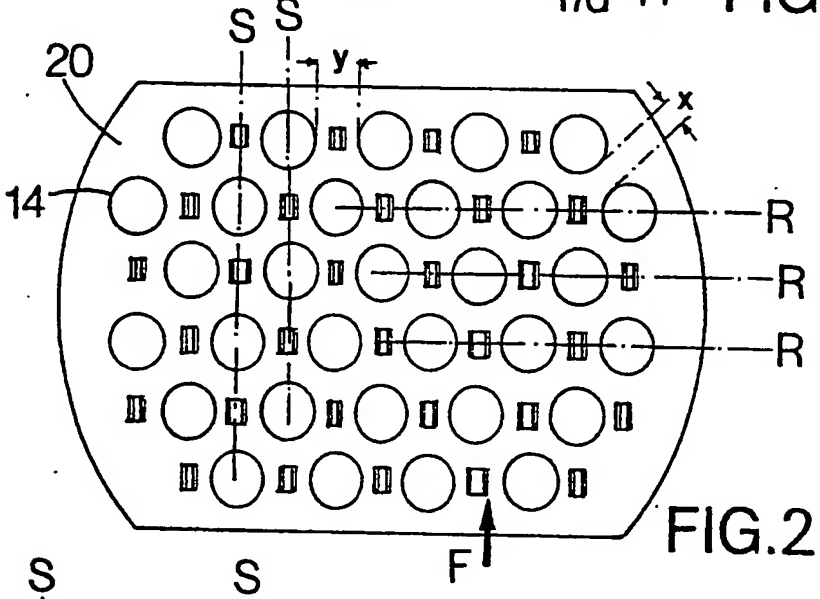

FIG.2

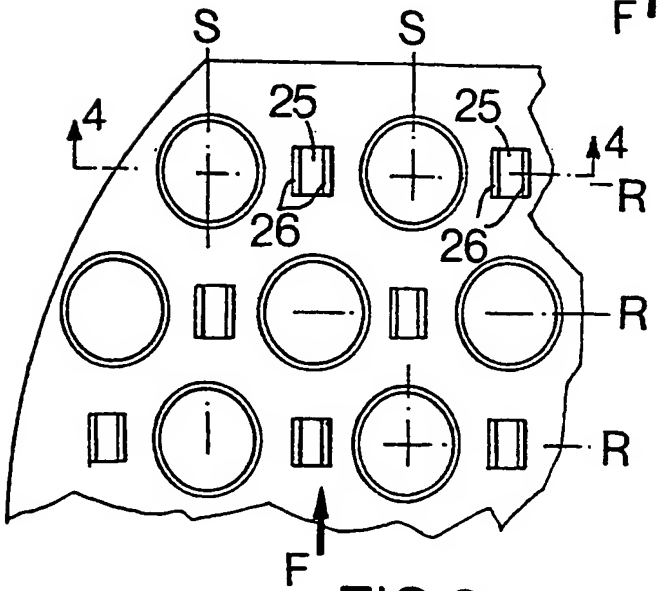

FIG.3

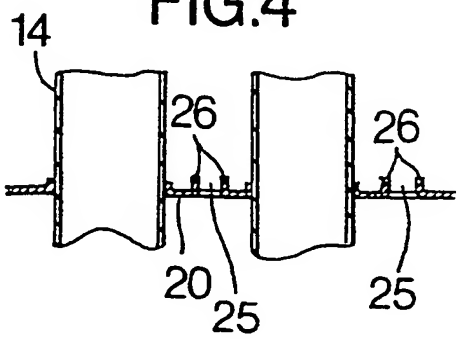

FIG.4